

SUPPORT FOR THE AMENDMENTS

This Amendment cancels Claims 3 and 9; and amends Claims 1, 20 and 21. Support for the amendments is found in the specification and claims as originally filed. In particular, support for Claim 1 is found in canceled Claim 3. No new matter would be introduced by entry of these amendments.

Upon entry of these amendments, Claims 1-2 and 5-8, 10-14, 17 and 19-21 will be pending in this application. Claims 1 and 8 are independent.

REMARKS

Applicants respectfully request entry of the foregoing and reexamination and reconsideration of the application, as amended, in light of the remarks that follow.

Applicants thank the Examiner for the courtesies extended to their representative during the January 9, 2004, personal interview. Applicants thank the Examiner for the indication at the interview that the above amendments appear to overcome the outstanding objection and rejections.

As discussed at the interview, the present invention provides a light, compact and thin battery having a positive and a negative electrode firmly joined together by an adhesive resin layer, which secures both electron insulation and ion conduction between the electrodes and decreases resistance between electrodes, i.e., internal resistance of the battery, to improve battery characteristics.

Claims 1-3, 5-7, 9, 14, 17 and 19-21 are rejected under 35 U.S.C. § 102(e)/103(a) over U.S. Patent No. 5,948,464 ("Delnick") as evidenced by U.S. Patent No. 6,096,456 ("Takeuchi"). Claims 10-13 are rejected under 35 U.S.C. § 103(a) over Delnick as evidenced by Takeuchi in view of U.S. Patent No. 6,287,720 ("Yamashita").

Delnick discloses an electrochemical cell comprising a cathode electrode and an anode electrode separated by a porous composite separator layer comprising a solid particulate material and a polymer binder. The separator can be formed by printing on one of the electrodes an ink containing the solid particulate material and the polymer binder.

Delnick discloses that typical binders include polyvinylidene fluoride-hexafluoropropylene copolymer.

Contrary to conventional terminology, Delnick designates his polyvinylidene fluoride-hexafluoropropylene copolymer as being "PVDF". See, Delnick at column 4, line 38; column 7, lines 12-15; column 10, lines 2-4; column 11, lines 31-32. In particular, Delnick discloses at column 7, lines 5-15, that:

It is understood by those skilled in the art, that the polymeric binder may consist of a **single polymer**, a mixture of polymers, or a mixture of polymers and copolymers. Monomers may be included in the ink formulation which are subsequently polymerized after printing the separator. Polymers of the ink formulation may be crosslinked chemically or by appropriate radiation subsequent to printing the separator. Typical binders that may be used for these purposes consist of: polyvinyl chloride (PVC), **polyvinylidene fluoride-hexafluoropropylene copolymer (PVDF)**, and ethylene propylene hexadiene monomer (EPDM). (Emphasis added.)

However, Delnick's "PVDF" (i.e., polyvinylidene fluoride-hexafluoropropylene copolymer) is not a "polyvinylidene fluoride homopolymer". Furthermore, "Examiner agrees that 'single' polymer does not suggest 'homopolymer'". Interview Summary dated January 9, 2004.

Because Delnick is silent about "polyvinylidene fluoride homopolymer", Delnick fails to suggest the independent Claim 1 limitation that "the adhesive resin comprises a polymer selected from the group consisting of polyvinylidene fluoride homopolymer and polyvinyl alcohol".

Claims 1-2, 5-7, 9, 14, 17 and 19-21 are rejected under 35 U.S.C. § 102(e)/103(a) over U.S. Patent No. 5,720,780 ("Liu") as evidenced by Takeuchi. Claims 10-13 are rejected under 35 U.S.C. § 103(a) over Liu as evidenced by Takeuchi in view of Yamashita. However, Claim 3 is not rejected over Liu. The specification discusses the Claim 3 feature that "an average particle size of the filler is equal to or smaller than a particle size of the active material constituting each electrode" at page 5, lines 3-21.

According to this mode, when the positive electrode and the negative electrode are joined with an adhesive resin, an adhesive resin solution having the adhesive resin dissolved in a solvent is hardly absorbed by the electrode active material so that it can be held as an adhesive resin layer to give necessary adhesive strength. Specification at page 5, lines 13-21

Claim 3 is canceled and incorporated into independent Claim 1. Thus, the pending claims are patentable over Liu.

Any *prima facie* case of obviousness based on the cited prior art is rebutted by the significant improvement in adhesive layer peel strength "in a range of from 50 gf/cm to 85 gf/cm" that is achieved in accordance with the invention of independent Claim 1 when "a weight ratio of the adhesive resin to the filler is not less than 1/5 and not more than 2" and "the adhesive resin comprises a polymer selected from the group consisting of polyvinylidene fluoride and polyvinyl alcohol". Table A and FIG. A from the Amendment After Final Rejection filed December 12, 2002, are reproduced below comparing inventive examples with a comparative example and Yamashita's examples.

TABLE A

| | Filler | Resin | Weight ratio (filler:resin) | Particle Size of Filler (μm) | Peel Strength (gf/cm) |
|--------------------------------------|-----------------------------------|-------|--------------------------------|---|-----------------------------|
| Example 17 | PMMA | PVDF | 1:2 | 0.5 | 80 |
| Example 6 | alumina | PVDF | 1:2 | 0.01 | 85 |
| Example 1 | alumina | PVDF | 1:1 | 0.01 | 70 |
| Example 3 | alumina | PVDF | 1:1 | 0.1 | 60 |
| Example 4 | alumina | PVDF | 1:1 | 1 | 65 |
| Example 8 | alumina | PVDF | 1:1 | 0.01 | 70 |
| Example 9 | alumina | PVDF | 1:1 | 0.01 | 70 |
| Example 10 | alumina | PVDF | 1:1 | 0.01 | 70 |
| Example 11 | alumina | PVDF | 1:1 | 0.01 | 60 |
| Example 12 | alumina | PVDF | 1:1 | 0.01 | 70 |
| Example 13 | silica | PVDF | 1:1 | 0.01 | 50 |
| Example 2 | alumina | PVA | 5:2 | 0.01 | 70 |
| Example 14 | silicon carbide | PVDF | 3:1 | 0.5 | 80 |
| Example 15 | boron carbide | PVDF | 3:1 | 0.5 | 80 |
| Example 16 | silicon nitride | PVDF | 3:1 | 0.5 | 80 |
| Example 7 | alumina | PVDF | 5:1 | 0.01 | 60 |
| | | | | | |
| Comparative Example 5 | alumina | PVDF | 10:1 | 0.01 | 20 |
| | | | | | |
| Yamashita's Examples 2 and 4-7 | alumina, zeolite or aramide | PVDF | 20:1 | alumina: 1.0 (otherwise silent) | ? |

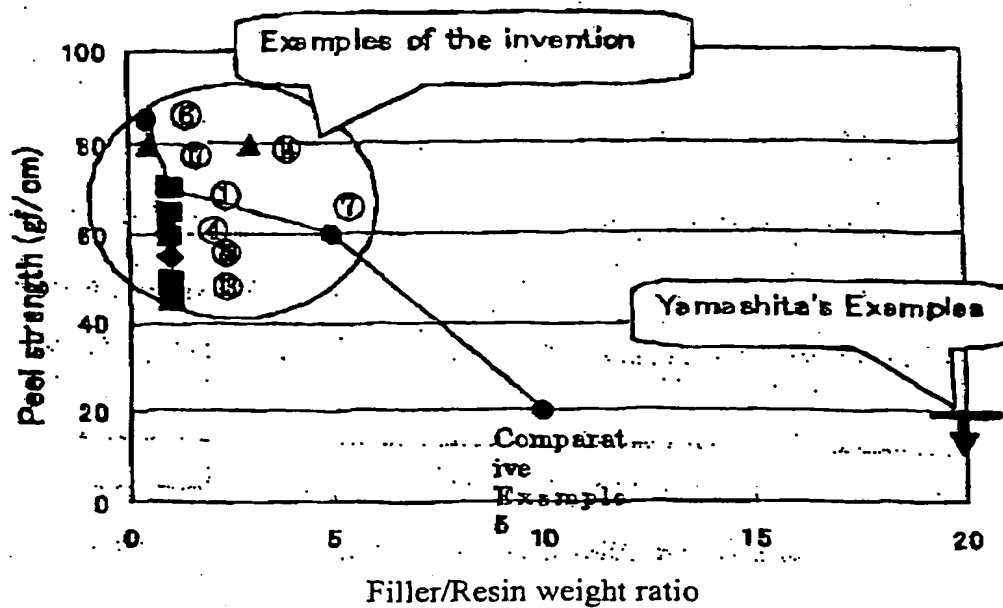


FIG. A: Comparison of peel strength

The cited prior art fails to suggest the significant improvement in adhesive layer peel strength shown in Table A and FIG. A. The Office Action admits that "Delnick is silent regarding ... a peel strength in a range of from 50 gf/cm to 85 gf/cm". Office Action at page 4, lines 10-11. Furthermore, as discussed above, Delnick is silent about polyvinylidene fluoride homopolymer. Moreover, the Office Action admits that "Liu is silent regarding ... a peel strength in a range of from 50 gf/cm to 85 gf/cm". Office Action at page 7, lines 10-11.

Because the cited prior art fails to suggest the significant improvement in adhesive layer peel strength "in a range of from 50 gf/cm to 85 gf/cm" that is achieved in accordance with the invention of independent Claim 1 when "a weight ratio of the adhesive resin to the filler is not less than 1/5 and not more than 2" and "the adhesive resin comprises a polymer selected from the group consisting of polyvinylidene fluoride homopolymer and polyvinyl alcohol", any *prima facie* case of obviousness based on the cited prior art is rebutted. Thus, the cited prior art fails to have rendered obvious the claimed invention.

Claim 9 is objected to. To obviate the objection, Claim 9 is canceled.

Pursuant to M.P.E.P. §821.04, after independent product Claim 1 is allowed, Applicants respectfully request examination of method Claim 14, which includes all of the limitations of product Claim 1.

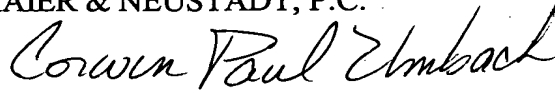
Applicants thank the Examiner for the indication that Claim 8 has been allowed. Office Action at page 2, line 4.

In view of the foregoing amendments and remarks, Applicants respectfully submit that the application is in condition for allowance. Applicants respectfully request favorable consideration and prompt allowance of the application.

Should the Examiner believe that anything further is necessary in order to place the application in even better condition for allowance, the Examiner is invited to contact Applicants' undersigned attorney at the telephone number listed below.

Respectfully submitted,

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